Money Growth and Inflation: A Case Study of Bangladesh

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Abstract

This study investigates the causal factors of inflation with a special focus in identifying the time lag of price responses to changes in the money stock in Bangladesh. Engle and Granger's (1987) two-step single equation error correction model (ECM), Granger Causality test and cointegration technique are employed based on quarterly data during 1974Q1-2003Q4 for Bangladesh.

Estimated results of the ECM model indicate that the growth of money supply, the growth of real income and real interest rate are important factors in explaining inflation in Bangladesh. The long-run response of inflation to changes in the money stock is, however, far less than the monetarists' predicted value of unity implying non-neutrality of money. The outcome regarding the time lag of price responses to changes in the money stock indicate that the response of inflation to changes in the money stock shows up after 4 quarters. Therefore, an increase in the money growth today will generate inflation after one year. The results from the Granger Causality tests indicate that the causality between money growth and inflation or real income growth and inflation runs only from money growth to inflation or real income growth to inflation indicating money and real income growth are important factors in predicting future inflation but inflation is not helpful in predicting money or income growth. The results of Johansen's cointegration tests suggest cointegration among the price level, real income, and money establishing long-run equilibrium relationship among them. Long-run data plot for M1 and M2 multiplier indicate that M1 multiplier is declining whereas M2 multiplier is increasing with a strong contribution from time deposits.

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1. Introduction

Although inflation is generally thought of as an inordinate increase in the general price level, throughout the history of economics the causes of inflation and the definition of inflation itself remained as an unresolved issue. There is a general agreement that, in the long-run, inflation is a monetary phenomenon. In short-run, however, many other factors could cause inflation that instigates unsettled debate on the causes of inflation. Every school of economists tries to define inflation and explain the causes of inflation in their own way. The heterogeneity of views on inflation does not only exist among various group of economists but it is strong enough also among economists of the same group. The disagreement among the Keynesians is obvious from the writings of Sidney Weintraub (1961, P. 26). He writes, *"... ... ..., the inflation issue, their views have split them into separate camps of 'demand-pull' and 'cost-push', or some uneasy amalgam of the two, as with varying intensity they have examined the always partial and inclusive empirical evidence."*

However, the so-called 'inflationary gap' or 'excess demand' is considered to be the main cause of inflation in the mainstream Keynesian economics. On the other hand, Professor Frederic S. Mishkin writes that as long as inflation is appropriately defined to be a sustained inflation, macroeconomic analysis, whether of the monetarist or Keynesian persuasion, leads to agreement with Milton Friedman's famous dictum, "Inflation is always and everywhere a monetary phenomenon[1].

With a view to identifying the most important sources of inflation in emerging countries, Lougani and Swagel (2001) examines the experience of 53 developing countries during 1964-1998 using a six variable vector autoregressions (VARs) approach. Their findings suggest that either money growth or exchange rate movement accounts for two-thirds of the variance of inflation at both short and long horizons. The authors also show that inflation expectation plays an important role in inflation determination in emerging economies. Kibritciouglu surveys a large number of literature to identify possible causes of inflation in Turkey and finds that inflation can be interpreted as a net result of sophisticated and continuous interaction of demand side (or monetary), supply side (or real) shocks, price adjustments (or inertial), and political process (or institutional) factors.

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1 Frederic S. Mishkin, "*Causes of inflation*", Working Paper Series # 1453, National Bureau of Economic Research, Inc., P. (ii).

The objective of this study is to conduct an empirical investigation regarding the causes of inflation in Bangladesh with a special focus on identifying the time lag of price responses to changes in the money stock using Engle and Granger's (1987) two-step single equation error correction model (ECM), Granger Causality and cointegration technique. Following Ali Darrat (1986), this is an attempt to explain inflation from the monetarist point of view using quarterly data during 1974Q1-2003Q4.

2. Theoretical Background

This study considers the issue of inflation as a purely monetary phenomenon. The simple version of monetarists' approach can be explained as the result of excessive growth rate of nominal money supply over that of real money demand. Given a reasonably stable real money demand function, high inflation would then be the outcome of high money supply growth. Therefore, inflation can be defined[2] as:

$$\dot{P} = \dot{M}^{s} - \left(\frac{M}{P}\right)^{d} \tag{1}$$

Where, $\dot{P}$ = rate of inflation;

$\dot{M}^{s}$ = rate of change in nominal money supply; and

$$\left(\frac{M}{P}\right)^{d} = \text{real money demand} = f\left(X^{e}, \dot{P}^{e}, r^{e}\right) \tag{2}$$

Here, X^{e} = expected real income;

$\dot{P}^{e}$ = expected rate of inflation to measure the yield foregone on real assets; and

r^{e} = expected rate of interest to measure the yield foregone on financial assets.

Replacing expected real income by current real income, expected rate of inflation by lagged inflation and expected rate of interest by current real rate of interest, we get the following reduced-form function from equation 1 and 2:

$$\dot{P}_{t} = f\left(\dot{M}^{s}, \dot{X}, \dot{P}_{t-1}, r\right) \tag{3}$$

2 Ali F. Darrat (1986), P. 88.

The monetarist approach to inflation predicts the following signs:

$$\frac{\partial f}{\partial M^s} > 0; \quad \frac{\partial f}{\partial X} < 0; \quad \frac{\partial f}{\partial P_{t-1}} > 0; \text{ and } \frac{\partial f}{\partial r} > 0.$$

Based on the above-mentioned theoretical background of the monetarist approach to inflation and utilizing the common adaptive-expectation scheme to approximate the expectational variables, we could specify a simple model of inflation asn follows

$$\dot{P}_t = \beta_0 + \sum_{i=0}^{l_1} \beta_{1i} \dot{M}^s_{t-i} + \sum_{i=0}^{l_2} \beta_{2i} \dot{X}_{t-i} + \sum_{i=0}^{l_3} \beta_{3i} \dot{P}_{t-1-i} + \sum_{i=0}^{l_4} \beta_{4i} r_{t-i} + \varepsilon_t \tag{4}$$

In the context of open economy macroeconomics[3] equation (4) could be rewritten as:

$$\dot{P}_t = \beta_0 + \sum_{i=0}^{l_1} \beta_{1i} \dot{M}^s_{t-i} + \sum_{i=0}^{l_2} \beta_{2i} \dot{X}_{t-i} + \sum_{i=0}^{l_3} \beta_{3i} \dot{P}_{t-1-i} + \sum_{i=0}^{l_4} \beta_{4i} r_{t-i} + \sum_{i=0}^{l_5} \beta_{5i} d_{t-i} + \varepsilon_t \tag{5}$$

Where, $\dot{P}$ denotes inflation, $\dot{M}$ denotes growth rate in nominal money supply, $\dot{X}$ denotes growth rate in real income, r denotes the real interest rates, d denotes the rate of depreciation, and ε is the error term. Expected signs for the cumulative coefficients are:

$$\sum \beta_{1i} \cong 1, \quad \sum \beta_{2i} < 0, \quad \sum \beta_{3i} > 0, \quad \sum \beta_{4i} > 0, \text{ and } \sum \beta_{5i} > 0$$

An increase in money supply will breed an upward pressure in the price level. According to the monetarists' policy ineffective proposition, there would be one-to-one relationship between money and price. In the long-run, money and price will grow at the same rate setting the coefficient of money supply to one. As real output increases, the aggregate supply curve shifts to the right, results in a decline in the aggregate price level and hence lower inflation. An inflationary expectation leads to higher future inflation implying a positive coefficient on the lagged inflation. The real rate of interest is nothing but the real cost of borrowing. As the real rate of interest falls, the cost of borrowing goes down leading to higher investment, employment and output, which will lower inflation. Given the

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3 In the context of open economy macroeconomics, the domestic price can be written as a summation of the prices of tradable and non-tradable goods. Under the Purchasing Power Parity (PPP) condition, it can be shown that there is a one-to-one relationship between the price of tradables and the exchange rate. Therefore, the rate of domestic currency depreciation is considered an important element of the domestic price movement (See Hossain, 2000, pp.139-142 for more details).

Purchasing Power Parity (PPP) condition and fixed foreign price, depreciation in the exchange rate translates into an increase in the price of tradables and thus leads to an increase in the domestic price level (Hossain, 2000, pp.139-142). Therefore, the sign of the coefficient on the rate of depreciation is also expected to be positive.

3. Data

Quarterly data on Consumer Price Index (CPI), Industrial Production Index (IPI) as a proxy for real GDP, Narrow Money (M1), Broad Money (M2), Reserve Money (RM), and real interest rate[4] are taken from the International Financial Statistics (IFS) CD-ROM of the IMF during 1974Q1—2003Q4. Seasonality in CPI, IPI, M1, M2, and in RM are removed through X-12 quarterly seasonal adjustment method developed by U. S. Department of Commerce and U. S. Census Bureau of the United States.

4. Preliminary Data Analysis

The intention of this study is to conduct an empirical investigation regarding the causes of inflation in Bangladesh with a special focus on identifying the time lag of price responses to changes in the money stock based on Engle and Granger's (1987) two-step single equation error correction model (ECM), Granger Causality and cointegration technique. We know that an OLS equation would produce a spurious relationship among the variables when there is a common trend in the data. Furthermore, the equation will be misspecified, in terms of wrong error, if the integrated variables (non-stationary) of the model are cointegrated (Engle-Granger, 1987). Therefore, before attempting to estimate the model, we need to check the presence of unit root in each variable and the presence of co-integration among the same integrated variables. If all of the integrated variables are co-integrated, we need to correct the error term of the OLS model by incorporating an error correction term in the model known as Engle, and Granger's (1987) two-step single equation error correction model (ECM).

Accordingly, a series of unit root tests, such as Dickey-Fuller (DF, 1981), Phillips-Perron (PP, 1988), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992) are used to determine the order of integration for each series. Johansen's (1988) cointegration test is applied to identify the presence of cointegration among the integrated variables. The results of unit root tests are reported in Table 1

[4] Calculated by subtracting expected inflation from bank rate.

Table 1 : Results of Unit-Root Tests

Variables (in log levels)	Without Trend			With Trend			Decision
	DF	PP	KPSS	DF	PP	KPSS	
Consumer Price Index (CPI)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Industrial Production Index (IPI)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)
Broad Money (M2)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Narrow Money (M1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Real Interest Rate (r)	I(0)	I(0)	I(0)	—	—	—	I(0)
Depreciation Rate (d)	I(0)	I(0)	I(0)	—	—	—	I(0)
Money (M2) Multiplier (MM2=M2/RM)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	Trend Stationary
Money (M1) Multiplier (MM1=M1/RM)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Quasi-Money (QM=M2-M1 Multiplier (MMQM= QM/RM)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	Trend Stationary

Notes: 1. Lag length for Augmented Dickey-Fuller (ADF) tests are decided based on Schwartz Information Criterion (SIC). 2. Maximum Bandwidth for PP and KPSS test are decided based on Newey-West (1994). 3. All the tests are performed based on 5% significance level. 4. = without log

The results of unit root tests indicate that Consumer Price Index (CPI), Industrial Production Index (IPI), and Money (M2 or M1) are non-stationary variables and they all have unit root I(1). The rest of the two variables of the model, i.e., the real interest rate and the depreciation rate are stationary and are said to be I(0) variables. The results[5] of the Johansen's cointegration test indicate that all of the I(1) variables are cointegrated. Accordingly, an error correction term[6] (EC(-1)) is incorporated in the model.

5. Cointegration Test

The finding that many macro time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists,

[5] The results are based on the assumption of a constant and a linear trend in the data. Schwartz Information Criterion (SIC) is used to decide the optimal lag length that makes all the residuals White Noise.

[6] Usually, a lagged residual generated from the cointegrated variables.

the non-stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables. It has been shown (Table1) that the log of price level (CPI), real income (IPI), and money (M1 or M2) are non-stationary or I(1) series.

Johansen's (1988) cointegration test is used in the log-level forms of the price level, real income, and money. The results of the Johansen's cointegration test, as reported in Table 2, show that the log of price level, real income, and money (M2

Table 2 : Results of Cointegration Test

Part-I: [Series: Price, Money (M2) and Real Income]
Sample(adjusted): 1976:2 2003:2
Included observations: 109 after adjusting endpoints
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.169462	29.76251	29.68	35.65
At most 1	0.080106	9.523211	15.41	20.04
At most 2	0.003865	0.422061	3.76	6.65
Trace test indicates 1 cointegrating equation at the 5% level				
1 Cointegrating Equation(s):		Log likelihood	690.2068	
Normalized cointegrating coefficients (standard errors in parentheses)				
Price	M2	Income		
1.000000	-0.139696	-0.228215		
	(0.12735)	(0.43000)		

Part-II: [Series: Price, Money (M1) and Real Income]
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.203359	36.06639	29.68	35.65
At most 1	0.086032	11.28505	15.41	20.04
At most 2	0.013481	1.479478	3.76	6.65
Trace test indicates 1 cointegrating equation at both 5% and 1% levels				
1 Cointegrating Equation(s):		Log likelihood	625.9730	
Normalized cointegrating coefficients (standard errors in parentheses)				
Price	M_1	Income		
1.000000	1.367655	-2.197190		
	(0.60218)	(1.64765)		

or M1) are cointegrated with a unique cointegrating relation at 5% level indicating long-run equilibrium relationship among price, money and income.

6. Empirical Results

Estimated results of the ECM model are given in Table 3. Part-I of this table reports the cumulative coefficients of the explanatory variables and Part-II contains the estimated coefficients on the individual lag of money. The regression results as displayed in Part-I indicate that the sum of estimated coefficients on all of the explanatory variables appears with expected signs with the exception of the coefficient on the rate of depreciation. The coefficients on the rate of depreciation and lagged inflation are not statistically significant when money is denoted by M2. The coefficient on growth rate of nominal money supply and real GDP growth rate are statistically significant at least at 10% level regardless of the definition of money.

The positive sign on the coefficient of money, as expected from the monetarist model of inflation, implies that an increase in the money supply or an expansionary monetary policy will generate inflation. The monetarists' policy ineffectiveness or neutrality of money proposition requires that the cumulative coefficient on money would be equal to one. A t-test on the cumulative coefficient of money suggests that the null hypothesis of unitary value is rejected at 1% level for both the definitions of money[7]. Therefore, the monetary model of inflation does not adequately explain the behavior of prices in Bangladesh where money is not completely neutral. This is because of the fact that the Bangladesh economy may have excess capacity where an expansionary monetary policy will increase employment and output with a moderate inflation.

In order to identify the lag structure of price responses to changes in the money stock, we need to examine the coefficient of money at individual lag. The results as reported in the second part of Table 3 indicate that the response of inflation to changes in the money stock at lag-4 is positive and statistically significant at 1% level for both measures of money. Therefore, an expansionary monetary policy at a point in time will generate inflation right after one year (4 quarters). The estimated value of Q-statistic shows that the residual of the model is White Noise indicating no serial correlation. As we are dealing with the time series data, the problem of heteroscedasticity is not an issue of concern. The White Heteroscedasticity test indicates that there is no heteroscedasticity in the model as

7 The calculated t-ratios are -4.18 and -7.40 for M2 and M1 respectively.

Table 3 : The Regression Results of ECM Model

$$\dot{P}_t = \beta_0 + \sum_{i=0}^{l_1} \beta_{1i} \dot{M}^s_{t-i} + \sum_{i=0}^{l_2} \beta_{2i} \dot{X}_{t-i} + \sum_{i=0}^{l_3} \beta_{3i} \dot{P}_{t-1-i} + \sum_{i=0}^{l_4} \beta_{4i} r_{t-i} + \sum_{i=0}^{l_5} \beta_{5i} d_{t-i} + \beta_6 EC(-1) + \varepsilon_t$$

When Money is	Const.	**Part-I: Estimates of Cumulative Coefficient on**						Equation Statistics	
		$\dot{M}^s_{t-i}$	$\dot{X}_{t-i}$	$\dot{P}_{t-1-i}$	r_{t-i}	d_{t-i}	**EC(-1)**	$\bar{R}^2$	**DW**
M2	-0.02*	0.29*	-0.05*	0.22	0.003**	-0.13	-0.20***	0.31	1.93
	(-1.70)	(1.70)	(-1.84)	(1.52)	(2.38)	(-1.43)	(-3.62)		
M1	-0.02**	0.26***	-0.04*	0.34***	0.004***	-0.22***	-0.07***	0.30	2.03
	(-2.20)	(2.54)	(-1.66)	(2.78)	(3.65)	(-2.65)	(-2.59)		

Part-II: **Estimates of Coefficients at Individual Lag of Money**

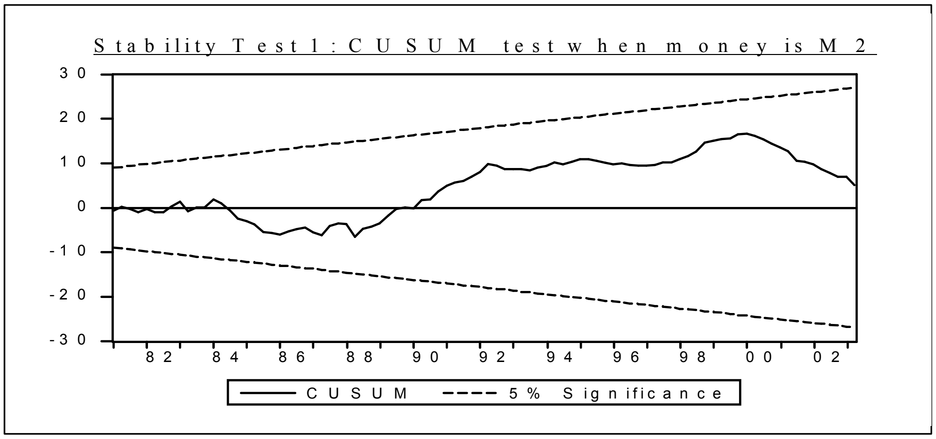
When Money is	Coefficients on Money at					Equation Statistics	
	No lag	Lag 1	Lag 2	Lag 3	Lag 4	$\bar{R}^2$	**DW**
M2	-0.05	0.02	0.03	0.08	0.21***	0.31	1.93
	(-0.68)	(0.27)	(0.44)	(1.05)	(2.75)		
M1	-0.02	0.01	0.03	0.05	0.19***	0.30	2.03
	(-0.41)	(0.16)	(0.59)	(1.16)	(4.25)		

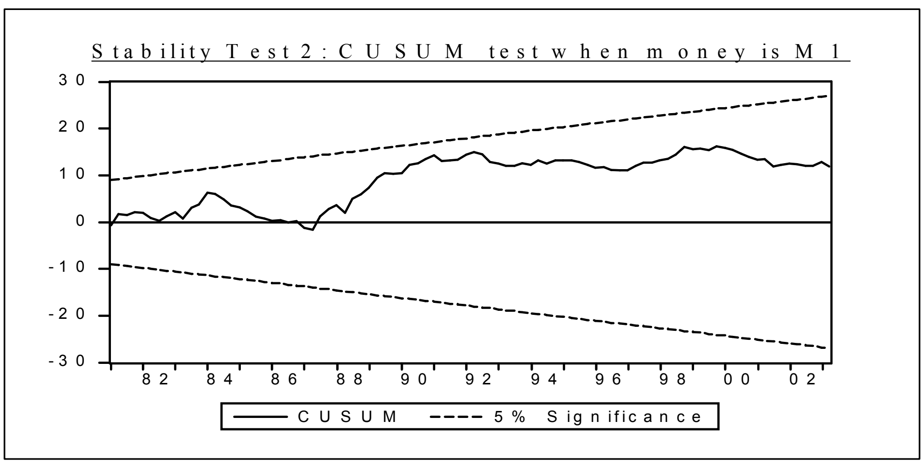
Notes:
1. *, **, and *** imply significant at 10%, 5% and 1% level respectively.
2. Figures in the parentheses are t-values.
3. DW and Q-statistic show that the residual of the model is White Noise indicating no autocorrelation.
4. In estimating ECM model, the maximum number of lag is set at 8 for each variable and it is reduced by one until the last lag become significant.

expected. The adjusted R-square for both equations is around 30%, which is quite reasonable especially when we are using variables in their growth form. The CUSUM test[8] is applied to check stability of the estimated equations. The output of the CUSUM test is reported in Figure 1 showing a reasonable stability in both of the equations as the plots of CUSUM lie within the two critical lines over the all time horizon.

[8] The CUSUM test is based on the cumulative sum of the recursive residuals. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines.

Figure 1 : Stability of the Model (CUSUM test)





7. Granger Causality Test

The concept of Granger Causality is introduced by Granger (1969) to see how much of the current value of '*y*' can be explained by the past values of '*y*' itself and the past values of other variable, say '*x*'. Consider the following equation:

$$y_t = \alpha_0 + \sum_{i=1}^{l} \alpha_i y_{t-i} + \sum_{i=1}^{l} \beta_i x_{t-i} \tag{6}$$

If the coefficients on the lagged *x's* (i.e., 's) are statistically significant then *y* is said to be Granger Caused[9] by *x*. In that case, *x* helps in the prediction of *y*. In addition to the pair-wise Granger Causality test expressed by equation (6), a vector autoregressions (VARs) based Granger Causality test has also been performed. In this case, we test causality between *x* and *y* in presence of other variables. Results of pair-wise Granger Causality tests and the VARs based Granger Causality tests are reported in Table 3 and 4 respectively.

Table 4 : Pair-wise Granger Causality Tests

Part-I: Pair-wise Granger Causality Tests when Money is M2

Sample: 1974:1 2003:4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
INF does not Granger Cause GRM2	109	1.05	0.39
GRM2 does not Granger Cause INF	6.35	0.00	
INF does not Granger Cause GRY	109	0.97	0.43
GRY does not Granger Cause INF	2.47	0.05	
R does not Granger Cause INF	108	2.31	0.06
INF does not Granger Cause R	1322.25	0.00	
DEP does not Granger Cause INF	109	1.24	0.30
INF does not Granger Cause DEP	0.63	0.64	

Part-II: Pair-wise Granger Causality Tests when Money is M1

Sample: 1974:1 2003:4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
INF does not Granger Cause GRY	109	0.97	0.43
GRY does not Granger Cause INF	2.47	0.05	
R does not Granger Cause INF	108	2.31	0.06
INF does not Granger Cause R	1322.25	0.00	
DEP does not Granger Cause INF	109	1.24	0.30
INF does not Granger Cause DEP	0.63	0.64	
GRM1 does not Granger Cause INF	109	4.76	0.00
INF does not Granger Cause GRM1	1.27	0.29	

9 It is important to note that the statement "*x* Granger causes *y*" does not imply that *y* is the effect or the result of *x*. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term.

Table 5 : VAR Based Granger Causality/Block Exogeneity Wald Tests

Part-I:

VAR Pair-wise Granger Causality/Block Exogeneity Wald Tests when Money is M2
Sample: 1974:1 2003:4
Included observations: 110
Dependent variable: INF

Exclude	Chi-sq	df	Prob.
GRM2	8.56	2	0.01
GRY	15.79	2	0.00
R	3.72	2	0.16
DEP	4.09	2	0.13
All	27.82	8	0.00

Dependent variable: GRM2

Exclude	Chi-sq	df	Prob.
INF	5.80	2	0.06
GRY	13.08	2	0.00
R	4.10	2	0.13
DEP	11.24	2	0.00
All	42.45	8	0.00

Part-II:

VAR Pairwise Granger Causality/Block Exogeneity Wald Tests when Money is M1
Sample: 1974:1 2003:4
Included observations: 108
Dependent variable: INF

Exclude	Chi-sq	df	Prob.
GRM1	15.40	4	0.00
GRY	5.52	4	0.24
R	10.19	4	0.04
DEP	2.01	16	0.73
All	41.93	0.24	0.00

Dependent variable: GRM1

Exclude	Chi-sq	df	Prob.
INF	1.90	4	0.75
GRY	2.42	4	0.66
R	2.65	4	0.62
DEP	1.31	4	0.86
All	10.46	16	0.84

The results as depicted in Table 4 indicate that the null hypothesis of money growth (M2 or M1) does not Granger Cause inflation is rejected at 1% level where the null of inflation does not Granger Cause money growth can not be rejected. This means the causality between money growth and inflation runs from money to inflation not the other way round implying that money growth is an important factor in predicting future inflation where inflation is not helpful in the prediction of money growth.

The causality between real income growth and inflation also runs from income growth to inflation (one-way causality). VAR based Granger Causality (Table 5) tests also produce similar results regarding the causality between money growth and inflation or real income growth and inflation. The results of the Granger Causality tests, however, confirm that there is a two-way causality between inflation and real interest rates. Therefore, money and real income growth and real interest rate are important in predicting future inflation in Bangladesh.

8. Behavior of Money Multiplier

Money multiplier plays a very important role in establishing monetary authority's precise control over money supply. Because monetary authority has precise control over monetary base, currency in circulation plus total reserves in the banking system, and money supply is a multiple (multiplier) of monetary base. Various factors could affect the magnitude of money multiplier.[10]

An increase in any of these ratios will reduce the magnitude of money multiplier. Some other factors, such as market interest rates and expected deposit outflows could affect money multiplier indirectly. An increase in the market interest rate will reduce excess reserve deposit ratio and hence increase money multiplier. On the other hand, an increase in the expected outflow of deposit will increase excess reserve deposit ratio and hence reduce money multiplier. The behavior of money multiplier in Bangladesh could be well understood from the graphical representation of both M1 and M2 multiplier as demonstrated in Figures 2, 3, and 4.

Figure-2 contains historical data plot of both M1 and M2 multipliers during 1974Q1-2003Q4 indicating an upward trend in M2 multiplier and an opposite, i.e., downward trend in M1 multiplier. This is because of an explosive growth in

[10] Directly, such as changes in the required reserve ratio, changes in the currency deposit ratio, and the changes in the excess reserve deposit ratio.

quasi-money[11] or time deposits, the difference between M2 and M1, as depicted in Figure-3 where the quasi-money as a ratio of reserve money is showing a strong long-run upward trend with some short-run fluctuations. Unit-root tests, as reported in Table-1, indicate that both M2 and quasi-money multiplier are trend stationary whereas M1 multiplier is a difference stationary or unit-root process.

Figure 2 : Data Plot of Money Multiplier

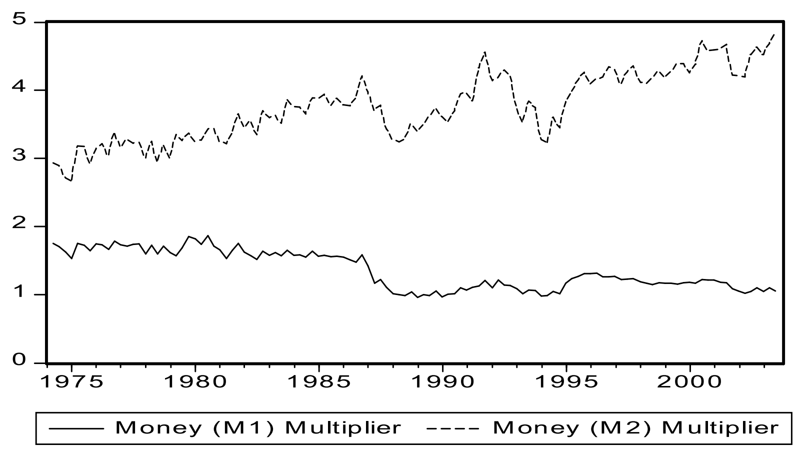
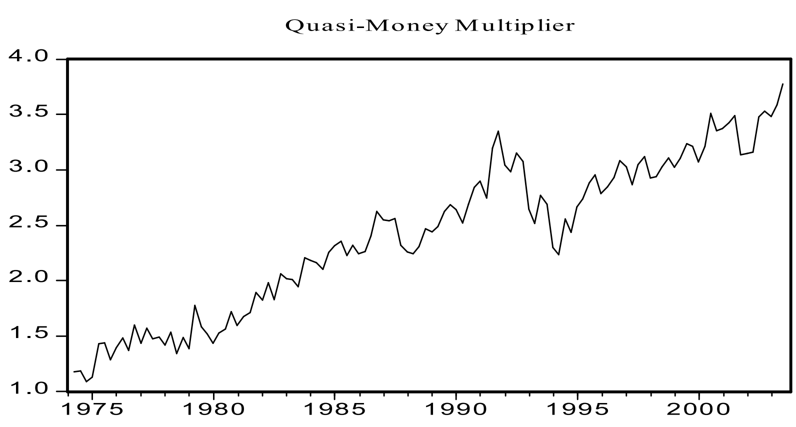


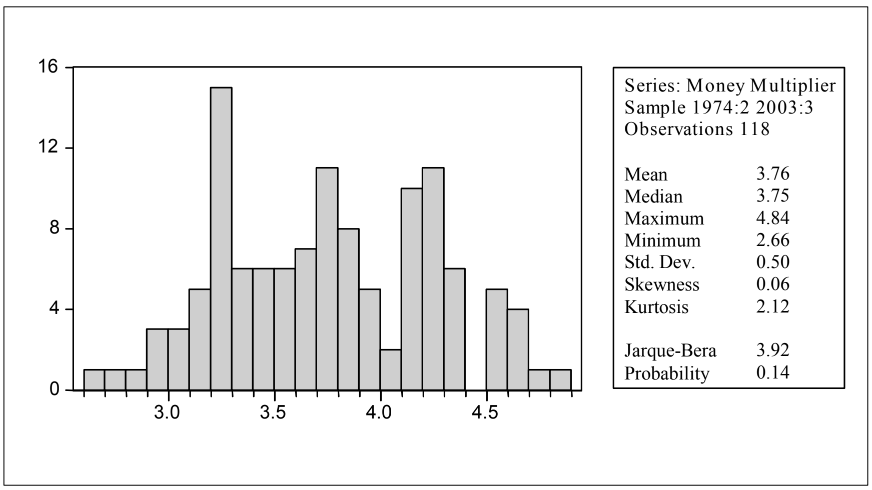
Figure 3 : Quasi-Money as a Ratio of Reserve Money

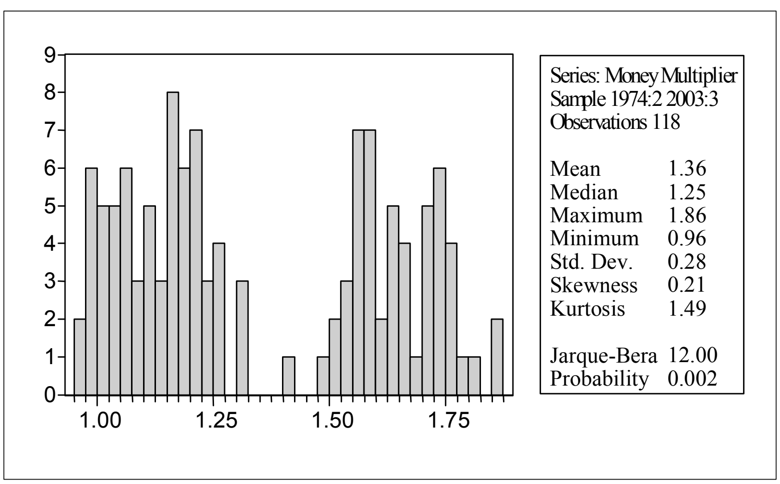


[11] For Bangladesh, major component of quasi-money is time deposits.

Some summary statistics on M1 and M2 multipliers during 1974Q1-2003Q4 are presented in Figure-4 with mean and standard deviation of 3.76 and 0.50 respectively for M2 multiplier and 1.36 and 0.28 respectively for M1 multiplier. Normality test, as shown by Jarque-Bera test statistic, indicates that M2 multiplier is relatively well behaved and normally distributed while the null of normal distribution for M1 multiplier is strongly rejected.

Figure 4 : Histogram and Other Descriptive Statistics of Money Multiplier





9. Summary and Conclusion

The study empiricaly investigates the causes of inflation in Bangladesh with a special focus in identifying the time lag of price responses to changes in the money stock and analyzing the behavior of money multiplier. In order to detect factors affecting inflation and to determine the time lag of price responses to changes in the money stock in Bangladesh, this study attempts to explain inflation from the monetarist point of view.

Estimated results of the ECM model indicate that the growth of money supply and real income are two important factors in explaining inflation. The positive and statistically significant response of inflation to changes in the money stocks shows up after 4 quarters. This is in line with the monetarists' approach to inflation. The cumulative response of inflation over 4-quarters to changes in the money stock is positive and significantly different from zero. However, the cumulative response of inflation to changes in the money stocks is far less than one i.e., 0.29 and 0.26 for M2 and M1 growth respectively indicating non-neutrality of money in Bangladesh. This has very interesting implication for Bangladesh economy implying presence of excess capacity where expansionary monetary policy will generate higher employment and output with moderate inflation. The results also confirm that real income growth and real interest are two other important factors in explaining inflation in Bangladesh.

The Granger Causality tests indicate that the causality between money growth and inflation runs only from money to inflation. The causality between real income growth and inflation also runs from income to inflation. These findings imply that money and income growth are important factors in predicting future inflation but inflation is not helpful in predicting money or income growth. The results of the Johansen's cointegration tests show that price level, real income, and money are cointegrated with a single cointegrating relation indicating long-run equilibrium relationship among them. Long-run data plot for M_1 and M_2 multiplier indicates that M_1 multiplier is declining where M_2 multiplier is increasing with a strong contribution from time deposits.

Bibliography

1. Darrat, Ali (1986), ***"**Money, Inflation, and Causality in the North African Countries*", Journal of Macroeconomics, Vol. 8, No. 1, PP. 87-103.
2. Dickey, D. A. and W. A. Fuller (1981), "Likelihood ratio statistics for autoregressive time series with unit root," *Econometrica,* 49, 1057-1072.
3. Engle, R. F. and C. W. Granger (1987), "Co-integration and Error Correction: Representation, Estimation, and Testing," *Econometrica*, 55:2, 251-276.
4. Mishkin, F. S. (1984), "*Causes of inflation*", Working Paper Series # 1453, National Bureau of Economic Research, Inc., P. (ii).
5. Granger, C.(1969), "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica,* 37, 424-438.
6. Hossain, Aktar (2000), "Exchange Rates, Capital Flows and International Trade", the University Publication Limited.
7. International Financial Statistics (IFS) CD ROM, *International Monetary Fund*.
8. Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control,* 12, 231-254.
9. Kibritcioglu, A. (2001), "Causes of Inflation in Turkey: A Literature Survey with Special Reference to Theories of Inflation", *Office of Research Working Paper Number 01-0115*, University of Illinois at Urbana-Champaign, USA.
10. Kwiatkowski, D., P. Phillips, P. Schmidt and Y. Shin (1992), "Testing the null hypothesis of stationarity against the alternative of a unit root," *Journal of Econometrics,* 54, 159-178.
11. Lougani, P. and P. Swagel (2001), "Sources of Inflation in Developing Countries", *IMF Working Paper WP/01/198*.
12. Newey, W. and K. West (1994), "Automatic Lag Selection in Covariance Matrix Estimation," *Review of Economic Studies*, 61, 631-653.
13. Phillips, P. and P. Perron (1988), "Testing for a Unit Root in Time Series Regression," *Biometrica,* 75:2, 335-346.
14. Rutledge, John (1974), "A Monetarist Model of Inflationary Expectations" *D.C. Heath and Company*.
15. Weintraub, S. (1961), **"**Classical Keynsianism Monetary Theory and the Price Level**"**, *Chilton Company*.